REPORT
TO THE
BOARD OF TRUSTEES
ON THE
OIL SANDS PROJECT
FROM
INCEPTION
TO
DECEMBER 31, 1948

PREPARED BY THE STAFF
OF
OIL SANDS PROJECT

FOREWORD

This report has been prepared at the request of the Board of Trustees who were appointed by the Government to direct and control general policy in matters concerning the Project.

It represents an effort to describe in general terms the activities of the Project from its inception to December 31, 1948. An attempt has been made to reduce technical discussions and theoretical speculations to a minimum in the belief that the result would be more useful and informative to a greater number of people.

Those desiring more detailed information are invited to contact the Staff of the Oil Sands Project.

W. E. ADKINS,

SUPERINTENDENT,

ALBERTA GOVERNMENT OIL SANDS PROJECT.

INTRODUCTION

The anxiety occasioned by expanding requirements for petroleum and its products is a matter of common knowlege. Demand now exceeds the ability of the industry to produce and no "levelling off" period is in sight. The reasons for this situation are readily apparent. Railways are swinging to Diesel power or to oil fired steam locomotives. Industrial consumption has increased as well as household heating requirements. The number of motor vehicles on the roads is at an all time high and will be augmented as automobile manufacturers fill existing orders. Aviation requirements are up and farmers are turning increasingly to Diesel and Gasoline burning machinery.

Canada as a net importer of crude oil must consider the world situation as regards petroleum supplies since we are dependent on surpluses from other nations to round out our dometic needs. Recent discoveries in Alberta have done much to brighten the picture but Canada as a whole still remains in a very deficient position as regards crude oil supplies. Much attention has also been given to expansion of crude oil production in the Middle East but strategic aspects of foreign oil sources must be considered since oil has become the mainstay of both our peacetime and wartime economy.

For many years the government has felt that the tremendous reserves of petroleum in the Alberta Oil Sands could provide a tremendous stabilizing influence if development indicated economic feasibility. In 1944 it was decided to take some concrete action toward the implementation of such a plan and after a study of the factors involved it was decided to construct a semi-commercial plant at Bitumount. It was further decided to build the plant in conjunction with Oil Sands Limited since they had proven leases of high grade oil sand and also certain other facilities in the way of camp buildings etc. which could be used until more satisfactory accommodation could be provided. Accordingly an agreement was entered into, through which and together with subsequent amendments, the government agreed to advance $500,000.00 towards the cost of construction. The company agreed to pay all amounts by which the cost exceeded $500,000.00 and further to administer the construction and operation of the project. The company's sole consideration was an option to buy the plant at cost when completed. Rising costs of material and labor forced construction costs over original estimates and the company was unable to raise money

to meet their obligations under the contract. In 1948 legal action by the government resulted in cancellation of the contract and obtainment by the government of sole ownership of the plant and all auxiliary equipment, etc.

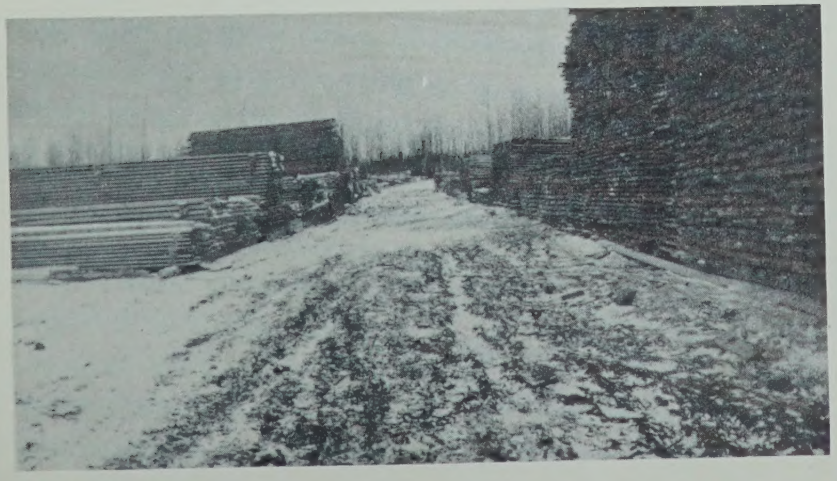
Construction of the plant was completed late in 1948 and although only a few short test runs were made results were so encouraging that it is considered essential that the present program be continued until such time as sufficient data can be accumulated to permit the design of full scale commercial plants. At the present stage of development economics of the process have not been sufficiently demonstrated to convince private industry that the investment would be attractive enough to warrant starting plant construction without some form of Govermental assistance. It is felt that this assistance can best be given in the form of experimental and development work such as has been presently undertaken.

General Summary of Construction and Operations

Since the plant is located 55 miles from the end of steel and in a rather remote locality much preparatory work had to be done before actual construction could get underway. Some means of transporting men and equipment to the site was necessary and this was provided in the form of a tug and two barges. It also became apparent that obtaining the large amount of lumber required from normal sources would be practically impossible and consequently suitable timber berths were obtained and logging operations were started in June, 1945. A complete sawmill was also moved inand erected so that it was not until February of 1946 that a sufficient stockpile of building materials had been accumulated to warrant proceeding with actual construction. In the succeeding months staff cabins, bunkhouses, garage, cookhouse, office,machine shop and warehouse were completed. Foundations for all plant buildings were poured and the structural steel for the Power House and Separation Plant was erected. Although considerable equipment had been designed fabricated and moved to the site by the end of the shipping season in 1946, sufficient material was not received to warrant keeping an erection crew on the job during the winter and accordingly operations were suspended until April of 1947. Despite every effort deliveries became increasingly slower and consequently a policy was adopted of keeping only sufficient men on the job to erect equipment as it was received. In other words deliveries regulated the rate of

LOGS READY
TO BE
MILLED

SAWMILL IN
OPERATION



FINISHED
LUMBER

progress of construction. Deliveries of all essential items were not completed until August of 1948. To further complicate matters a disastrous fire on May 24 completely destroyed the Warehouse and Machine Shop together with its contents and many items had to be replaced before operations could be started.

Finally on September 13 the Separation Plant was started up and several runs were made between that date and Oct. 22. As had been anticipated many mechanical difficulties developed which necessitated frequent shutdowns for repair and adjustment. In spite of these, however, operating results were most gratifying. Oil was produced at a rate exceeding design capacity and the quality of the separated oil was better than anticipated. It should be emphasized that these results were obtained with inexperienced operators and under conditions which allowed little time for refinement of operating technique and procedures.

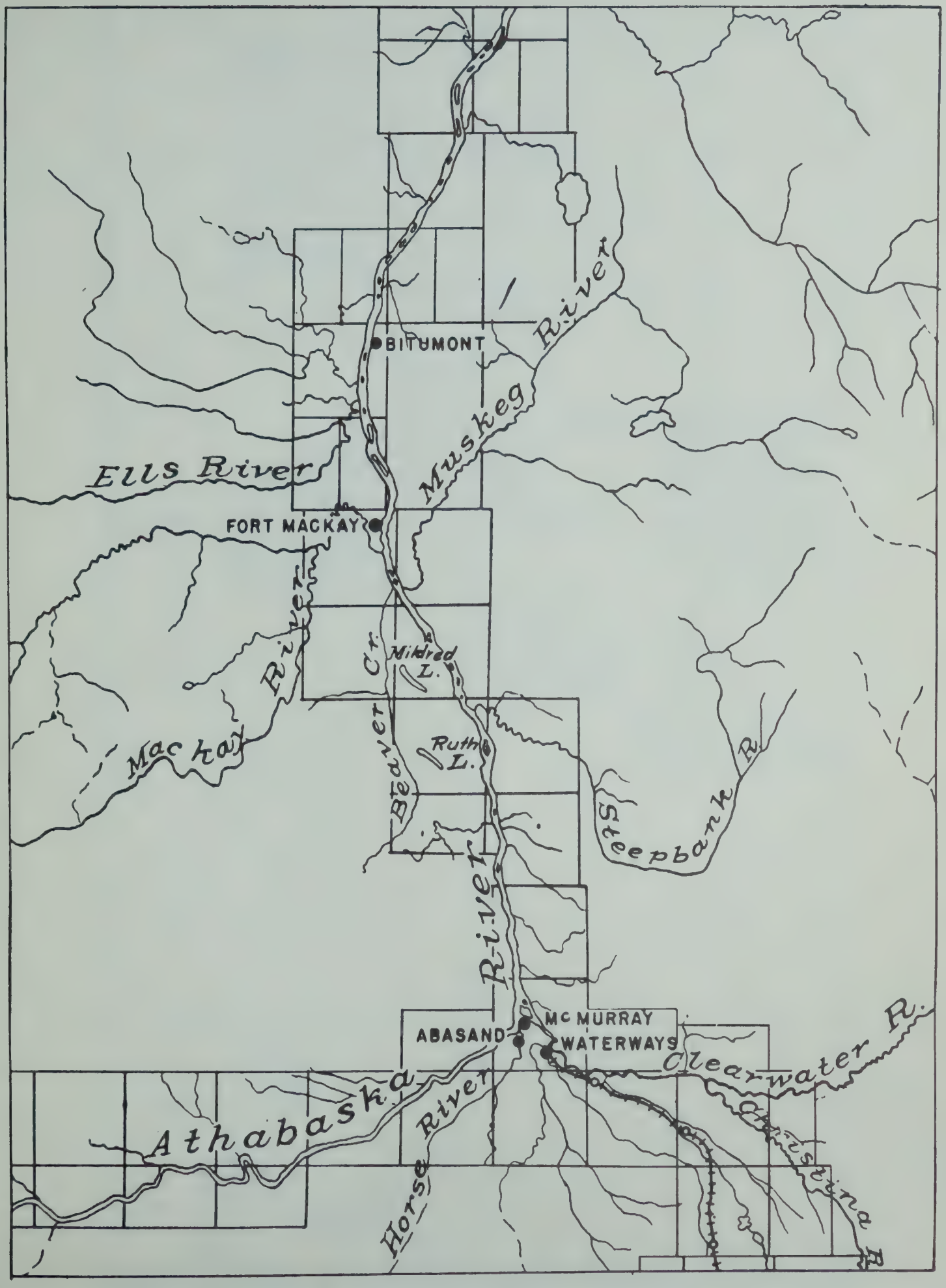
After consideration of the problems involved it was decided that it would be unwise to attempt operation under severe winter conditions and that a few months spent on redesign of some of the equipment would permit resumption of activities in the spring of 1949 without risking possible damage to equipment, piping, etc. during the winter.

Reserves

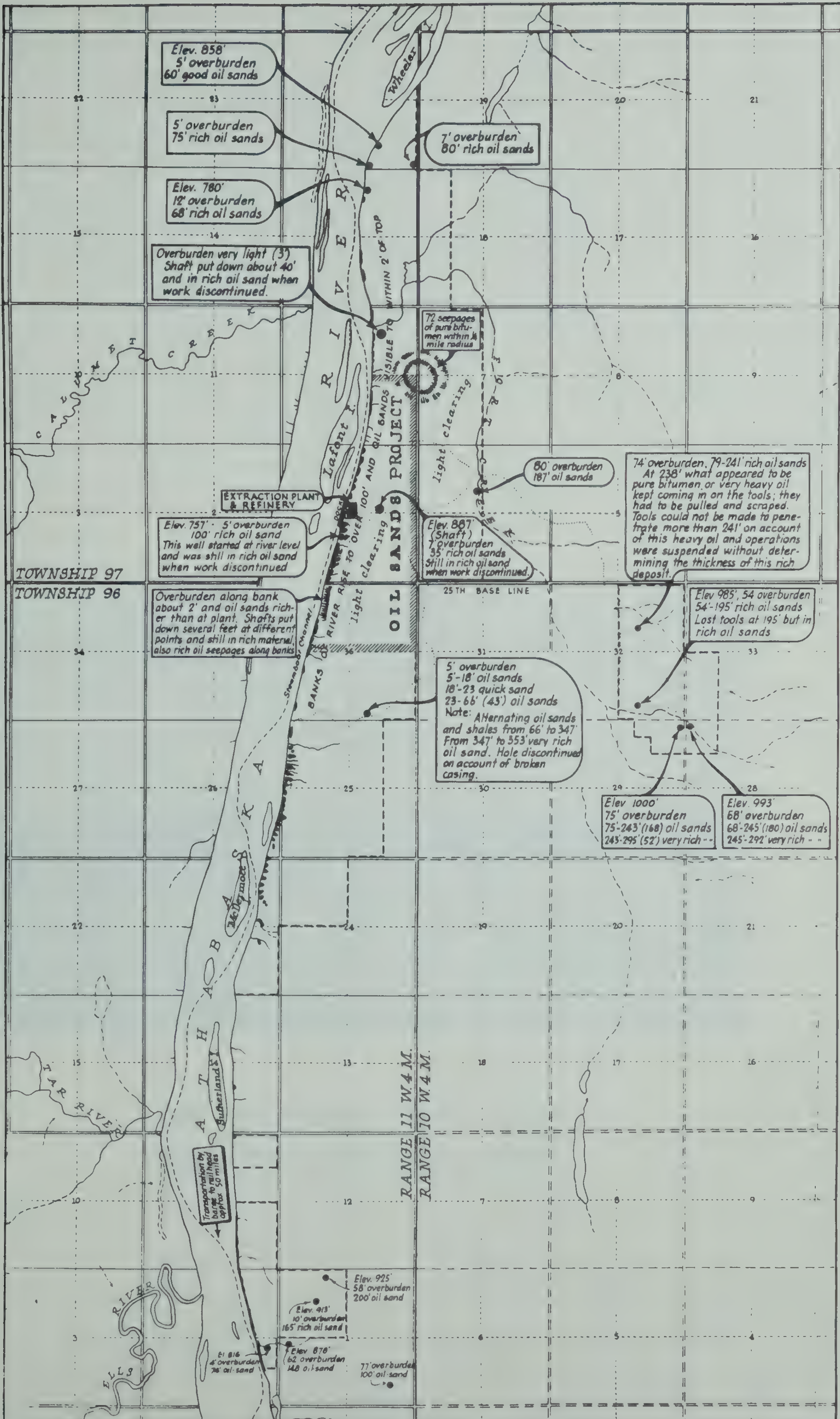
Estimates of the amount of oil contained in the Alberta Oil Sands have been made ranging from 100 to 500 billion barrels. Actually it is doubtful if sufficient exploratory work has been done to clearly define the limits of the deposit. Outcrops along the Athabaska River and its tributaries roughly define an area approximately 80 miles by 60 miles. It is known that the MacMurray formation is approximately 200 feet thick although it is by no means uniform. Localized drilling has revealed several rich deposits which would support large scale operations for many years. From the foregoing it can be assumed that the problem is not one of supply but rather of utilization.

Site Preparation

The Site chosen for the new plant is on the East side of the Athabaska River immediately south of the old Oil



MAP OF OIL SAND AREA



MAP SHOWING AREA IMMEDIATELY SURROUNDING PLANT

VIEW OF PLANT FROM RIVER
OPEN PIT MINE IS AT RIGHT

AERIAL VIEW OF PLANT

AND

SURROUNDING COUNTRY

Sands Limited plant. The River bank rises abruptly to about 65 feet above normal water level and then slopes gently upward to the east. This area is lightly wooded and there is about 4 feet of clay, humus and decayed vegetation on top of the Oil Sand. To prevent possible foundation difficulties a small creek immediately north of the plant was extended south along the east side of the property to divert sub surface water. (See Plot Plan).

A Dock was built early in 1946 and access roads provided. On top of the bank, road building presented quite a problem due to the unstable nature of the top soil and it was found necessary to excavate down to Oil Sand and to backfill with the same material in order to provide a solid road bed. While this involved considerable work it is felt that all weather roads particularly between the Mine and Separation Plant are essential to the successful operation of the plant.

As would be expected much backfilling and grading has been necessary to facilitate drainage and to improve the general appearance of the property.

Much of the plant area has been given a top dressing of gravel which combined with Oil Sand gives a very satisfactory surface.

Mine Development

The open pit mine, or quarry from which the Oil Sand is being removed has been opened up South of the plant in a strip about 200 feet wide paralleling the river. The actual mine face is open to the river to facilitate drainage. Mining will be carried out by working a 10 to 12 foot face about 900 feet in length, the face being worked back from the river for a distance of 200 feet on each successive lift. At the present time an area approximately 500 feet long by 200 feet wide has been stripped while an additional area 400 feet long by 200 feet wide has been partially stripped.

It is considered that at least 30 feet of Oil Sand can be removed from the present mine without developing serious grades on the access roads. This represents approximately 200,000 cubic yards which should keep the present plant operating at capacity for about 20 months. At the end of

STRIPPING OVERBURDEN WITH BULLDOZER

ENTRANCE TO OPEN PIT MINE LOOKING SOUTH

that time a decision will have to be made as to whether to extend the mine in which case hauls will be longer or whether to mine deeper, in which case grades would be quite stee p and drainage problems will develop at certain seasons of the year.

Mining equipment consists at present of a 3/4 yard Combination Shovel and Dragline, a large tractor equipped with a 12 foot hydraulic bulldozer and 3 - 4 yard dump trucks. All equipment is in good condition although it might be adviseable to replace the dump trucks at the end of another season and thus avert costly overhauls.

Experience to date indicates that this equipment can handle the mining satisfactorily. Under normal conditions sufficient sand for 24 hours operation can be mined in one eight hour shift, using two dump trucks. The third truck is kept as a spare so that no delays will result in the event of a breakdown.

Trucks operate on an 8 minute cycle when hauling 4 to 5 ton loads.

Loads are weighed on a 20 ton drive-on Scale located near the Separation Plant Storage Hopper. Under normal operation an average weight per load would be used with check weights being taken periodically.

As far as is know Oil Sand of the type available at Bitumount can be mined in the winter without difficulty When freezing temperatures are encountered, however, a large percent of the sand mined is lumpy. This presents no problem as far as mining is concerned but these lumps cause some trouble in the Separation Plant itself.

Sand being charged to the Separation Plant during test runs this year averaged about 9% oil by weight but test holes indicate that sands running 15% oil by weight will be reached at slightly lower levels. This will result in an increase of approximately 65% in oil production without handling additional tonnage.

In all upwards of 35,000 cubic yards of overburden and lean sand were removed from the mine prior to the commencement of operations.

EXCAVATING OIL SAND WITH POWER SHOVEL

TRUCK UNLOADING OIL SAND AT STORAGE HOPPER

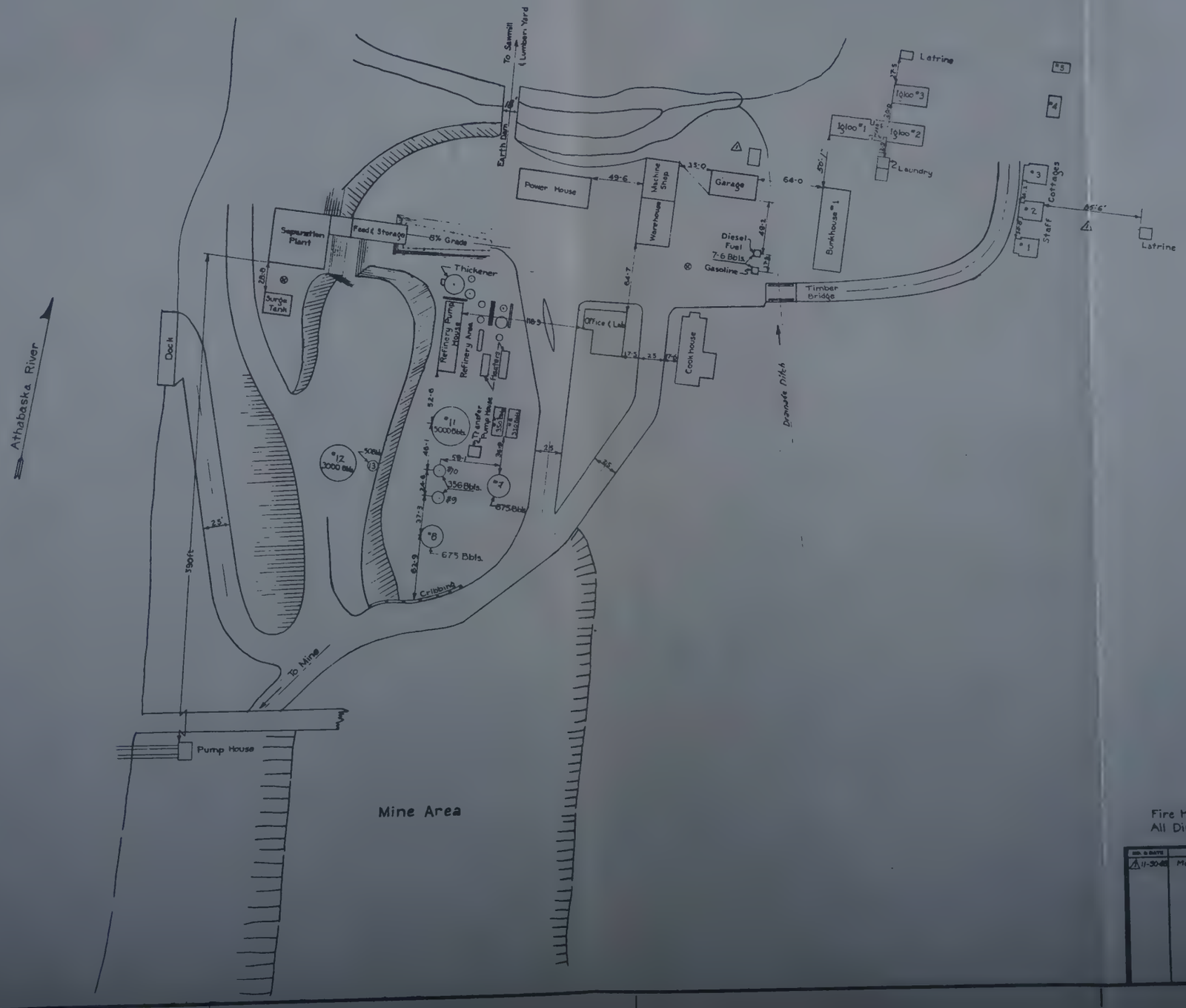
Engineering Development

There is nothing essentially new in the present plant. Practically every basic idea used has been tried before in some former plant and the present project represents an attempt to utilize all ideas of a worthwhile nature which have developed from past attempts to extract oil from oil sand. The basic Separation Unit follows closely the principles employed in the old Oil Sands Plant, however, the "mechanical expression" of these principles represents such a radical change that a cursory examination might lead one to believe that the new plant was quite different. Throughout the whole development Project Engineers have worked closely with Engineers of the Alberta Research Council who have had many years experience in the extraction of Oil from Oil Sands.

Using ideas obtained from the sources mentioned above Project Engineers worked out flow sheets representing their impressions of the equipment and sequence of operations required to arrive at a satisfactory operation. Points upon which divergent opinions were held were checked by actual test in laboratory scale equipment at the Laboratories of the Research Council. It was not until reasonable unanimity of ideas had been reached, by all those connected with the technical aspects of the project, that actual design work got underway. Practical difficulties encountered in the design necessitated still further changes so that considerable time was required to make up final working drawings which could be used for fabrication and erection.

Design

During the initial stages of the project the Project Engineers undertook to do all design work and prepare the necessary working drawings. As the project increased in scope and complexity, however, it became evident that a competent engineering firm should be employed for this purpose. Accordingly the Born Engineering Co. of Tulsa Oklahoma was retained as General Contractor. It might be mentioned that this firm enjoys an enviable reputation in the Refinery Engineering business in the United States. They had further been making inquiries into the problems encountered in Oil Sand extraction over a period of some years and had carried out minor investigations on the subject for some of their clients in United States.



Fire Hydrants Shown - ⊕
All Dimensions In Feet

NO. & DATE	REVISIONS
1 11-30-48	Moved Wood Shed

BORN ENGINEERING CO.
TULSA, OKLAHOMA

EXISTING PLANT LAYOUT

FOR ALBERTA GOVERNMENT OIL SANDS PROJECT

DRAWN BORN | SCALE 1" = 50' | DWG. 349-0
CHECKED C.M.S.

Since much of the process involves the movement and handling of material the services of a reputable designer and manufacturer of conveyors was needed and after a preliminary layout of the plant had been prepared several such companies were asked to submit designs and proposals. The Link-Belt Company of Toronto and Chicago were finally chosen for the job and they proceeded to design the equipment necessary to perform the required operations. Here again considerable readjustment of ideas was necessary in order to bring the original concept into line with practical aspects of conveyor design. It was not until November of 1945, therefore, that orders could be placed for the conveying equipment. Design of the Power House and Refinery followed conventional lines. Standard equipment was used troughout and no special features were incorporated.

It should also be mentioned that due to the heavy fire losses at previous plants in this area, every detail of design had to be checked with the Fire Underwriters Association. Plant Buildings are as nearly fireproof as possible. In buildings where oil is handled or processed combustible materials have been eleminated entirely. If this course had not been followed it would have been impossible to obtain coverage on any of the plant buildings or equipment. On the plant as finally built, a lower premium rate was obtained than had ever been considered possible in this area.

It must also be remembered that no definite data on plant scale operations was available so that the sizing of vessels, conveyors, speeds, etc. became largely a matter of judgement on the part of the designers. Naturally it has been found that readjustment of some of these is necessary and studies at present underway are aimed at correction of these deficiencies

The design capacity of 350 barrels per day was chosen as the minimum size which would give operating data and cost figures that could be accurately extrapolated to large scale requirements.

Construction

As has been previously mentioned actual construction

SEPARATION PLANT DURING CONSTRUCTION

did not get underway until early in February of 1946. At this time the sawmill was still being operated but a large stockpile of lumber of various dimensions had been accumu lated. Since it was impossible to move heavy plant equip ment to the plant site until navigation opened in May, all efforts were directed towards the completion of camp build ings, etc. so that the summer months would be available for work on the plant itself. In the months from February to June inclusive the following buildings were completed to the point where they could be occupied

3 Staff Cabins
1 Twelve Room Bunkhouse
1 Garage
1 Cookhouse and Mess Hall
1 Machine Shop and Warehouse
1 Office and Laboratory.

Since that time 2 more Staff Cabins have been added. All these buildings are of frame construction and sheeted in side with plasterboard with the exception of the warehouse which is lined with "Westile" a fireproof asbestos board, and the laboratory which is lined with Asbestos Millboard.

In view of the large amount of concrete required for foundations, buildings, etc. a great deal of time was spent in efforts to locate a suitable source of gravel. Many test pits were dug inland from the plant and samples tested at the University of Alberta. It was finally decided to use gravel from a fairly large deposit about $1\frac{1}{2}$ miles from the plant site. The pit run material from this particular bed was deficient in coarse aggregate but it was found that concrete of adequate strength could be made by proper control of mix. The only alternative to this would have been to set up a screening plant to produce aggregate. A passable trail existed between the plant site and the pit but it was by no means suitable for heavily loaded trucks Considerable work was required to bring it up to necessary standards. Much of it was surfaced with Oil Sand so that gravel hauling could be done in all kinds of weather

During the balance of 1946 practically all building and equipment foundations were poured. The Structural Steel for the Power House and Separation Plant was received and erected but siding material was impossible to obtain. Much of the Power House equipment was received and installed. A start was also made on the erection of equipment in the Separation Plant but failure of Link Belt to deliver any of

ERECTION OF REFINERY EQUIPMENT

POWER HOUSE IN BACKGROUND

the conveying equipment limited progress in this direction

As the shipping season drew to a close it became evident that sufficient equipment would not be received to warrant keeping an erection crew on the job all winter. It was decided, therefore, to suspend operations until the spring of 1947.

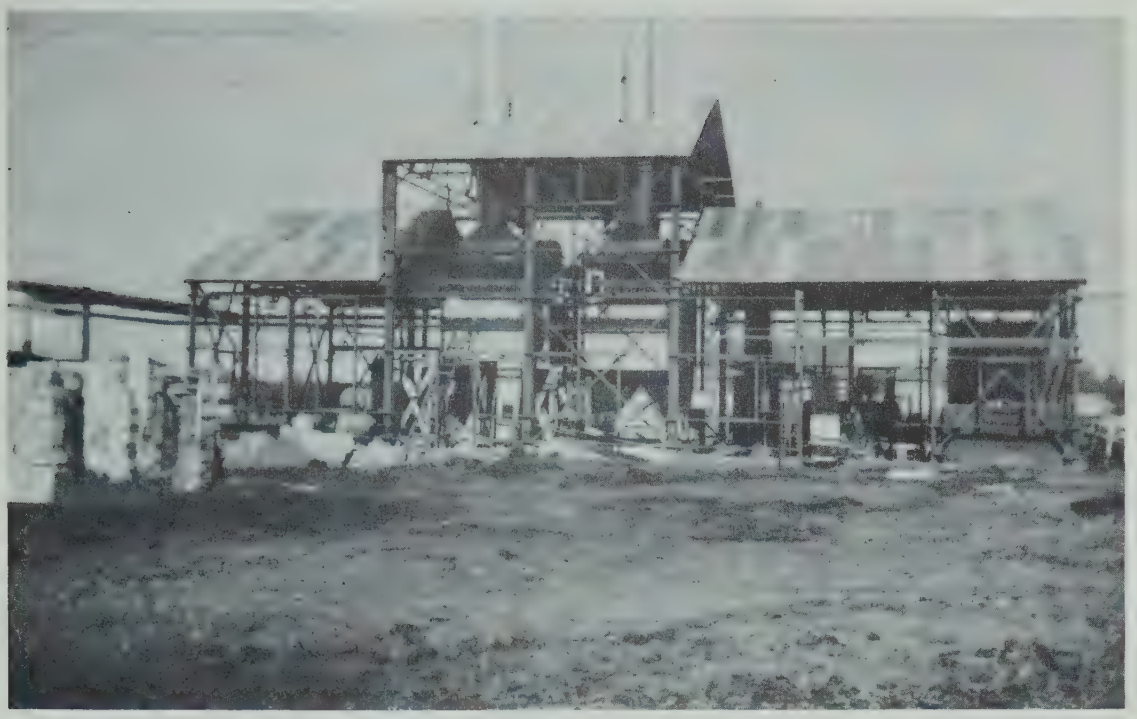
Construction was resumed in April of 1947 but as in 1946 failure of suppliers to keep delivery promises delayed progress. All Refinery vessels were not received until July 19 and this delayed the start of piping in the Refinery. Most of the conveyors and drives for the Separation Plant were received August 13, 1947 although the final shipment of conveying equipment was not received until July 30, 1948

In order to avoid further delays the structural Steel Framework for the Refinery Pump House, a building 66 feet long was fabricated at the plant site and corrugated asbestos board was substituted for corrugated iron as siding on both the Pumphouse and Separation Plant

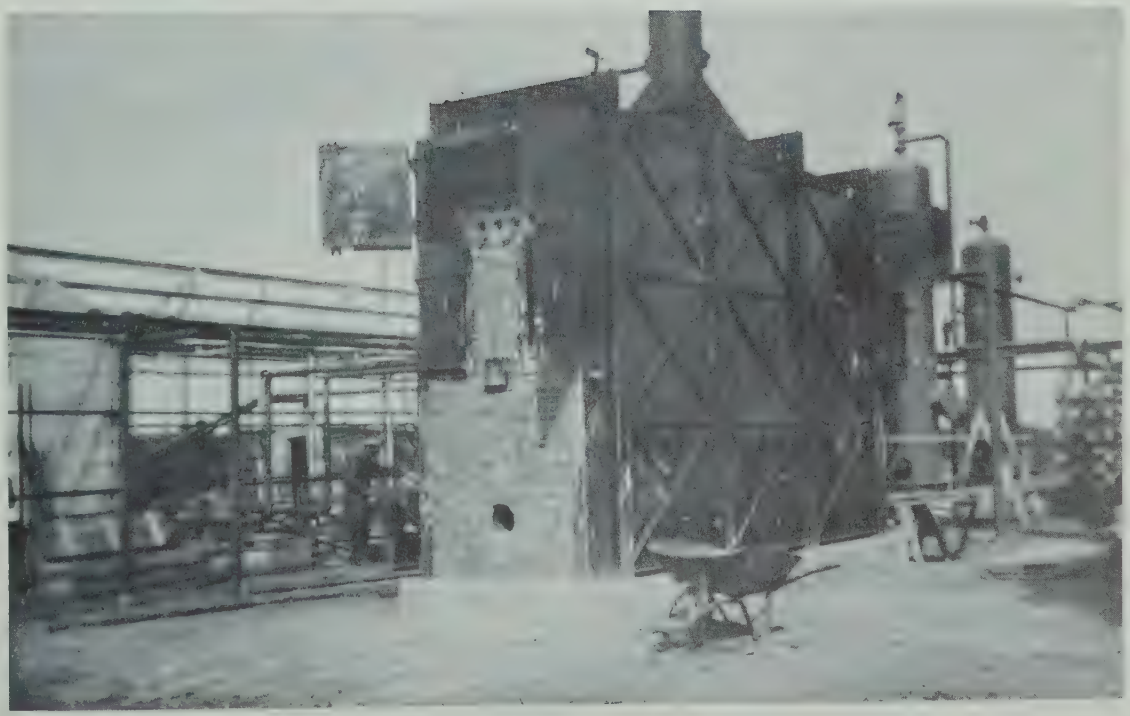
Despite these and other difficulties the bulk of construction was completed in 1947. During this period the following major buildings, etc. were completed.

Power House
Refinery
Dehydration Unit
Separation Plant
Crude Storage Tank (5,000 Barrel)
Fuel Oil Tanks (2) (350 Barrels each)
Diesel Rundown Tank
Naptha " "
Diluent " " (2) (350 Barrels each)
Diesel Storage Tank (partially completed)
3000 Barrels.

The only large unit which remained to be completed at the end of 1947 was the Water Pumphouse and Intake. This installation was located on the river bank about 550 feet south of the plant site. Completion had purposely been delayed until late in the year so that the water level would be lowest and so that it would be possible to work on the ice while laying the intake lines. This work was completed early in 1948. Unfortunately the river rose to an exceptionally high level following the spring thaws and



POWER HOUSE DURING CONSTRUCTION



ERECTION OF DEHYDRATION HEATER

SOME OF THE SEVERAL MILES OF PIPE
USED ON THE PROJECT

EXCAVATING FOR MAIN WATER LINE FROM RIVER

high currents caused unlooked for shifting of sand in the east channel with the result that the intake pipes became covered with approximately four feet of sand by August 1. Despite the efforts of a dredge operated by the Federal Department of Public Works the situation continued to deteriorate until the intakes were covered by approximately six feet of sand in October.

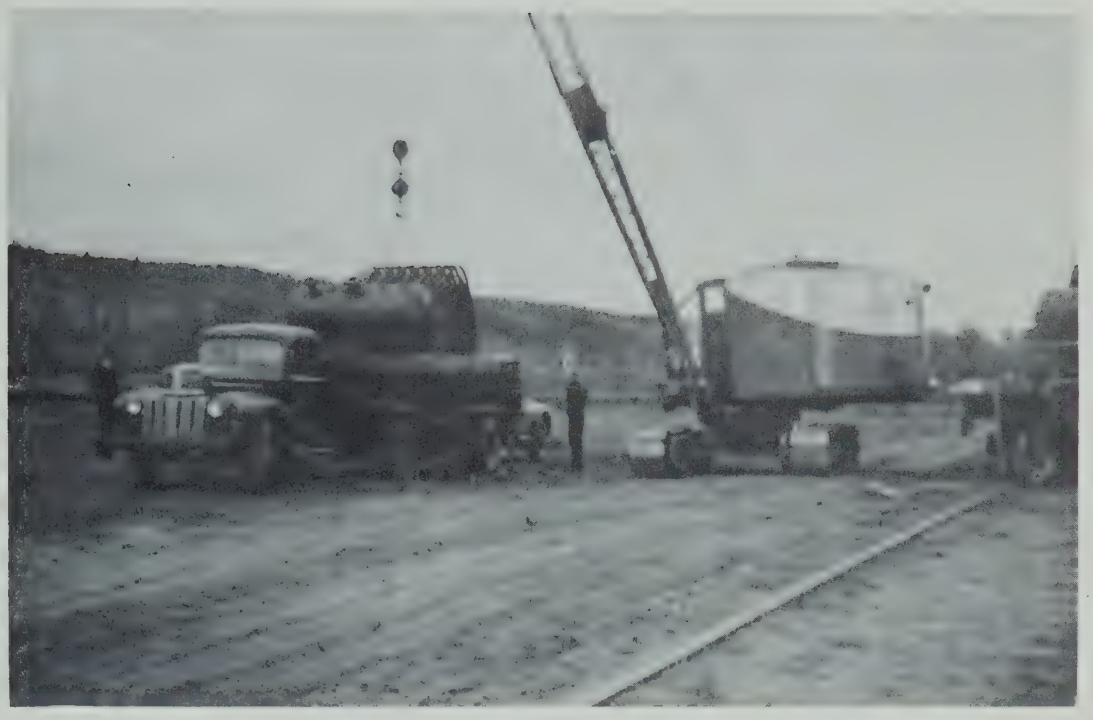
This development necessitated abandonment of the original pump house and the construction of a temporary intake at the south end of the dock.

The status of construction was such in May that it was confidently expected that operations could be started about July 1. This was prevented by the fire on May 24 which completely destroyed the Warehouse and Machine Shop. At the time most of the control instruments, gauges, etc required for the plant were in the warehouse where they were being left until just before operations commenced to avoid breakage. Replacement of these and other essential items, took more than three months and consequently it was impossible to commence operations until early in September

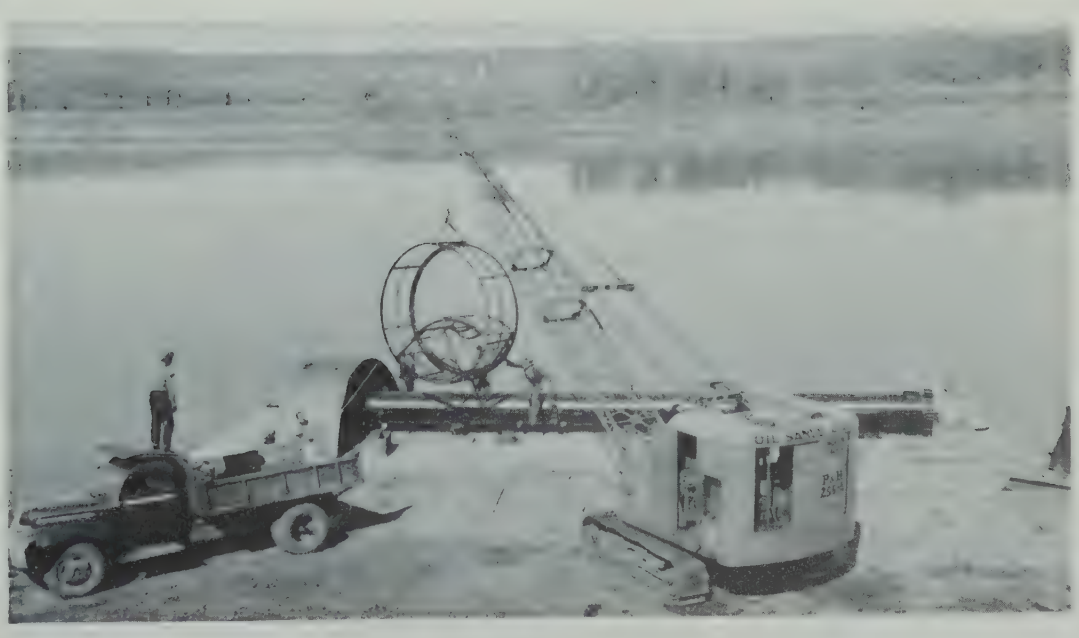
As can be easily visualized construction of a large industrial plant in this area presents many special problems and the experience gained on this project should be invaluable in the event of future expansion. To avoid costly delays the organization must be completely self sufficient both from the point of view of personnel and equipment. Further since transportation is exceedingly slow and expensive maximum utilization of naturally available building materials must be made if costs are to be kept within reason. Equipment primarily intended for the plant, but of such a nature that it can be used during construction, must be ordered and taken to the site at the earliest possible date. This would apply to Electric plants, portable pumps, mining equipment, trucks, etc. For the same reasons it is essential to keep a large and representative stock of spare parts on hand particularly for trucks, tractors, shovels and similar equipment.

Transportation

Due to the location of the plant transportation of equipment and supplies particularly during construction was one of the largest single problems with which those



UNLOADING EQUIPMENT FROM CARS
AT WATERWAYS



UNLOADING BARGE AT PLANT

in charge of the project had to contend. Since no roads exist between the end of rail at Waterways and the plant site, water transportation offers the only means of moving any volume of heavy equipment. In this locality water transportaion is restricted to approximately 5½ months from May to October so that it was necessary to move practically all material, required for a years' work, in this short period. To further complicate matters the water level is usually very low during September and October. This condition got so bad during 1948 that the boat was unable to dock at the plant and barges had to be unloaded at a point 1½ miles up stream

The following table gives a summary of the amount of freight moved during the three peak shipping seasons.

YEAR	TRIPS MADE	FRT. HANDLED POUNDS	TOTAL COSTS FOR SEASON	COST/TON
1946	29	1,255,164	8546.50	13.60
1947	40	1,069,487	7470.00	14.00
1948	39	1,289,197	7783.30	12.06

The cost per ton figure includes unloading from freight cars at Waterways, reloading on barges, unloading at Bitumount and spotting at point on job where material was to be used. In addition to freight, 450 passengers have been carried.

Although Bitumount is not a regular port of call with the common carriers on the river, the freight rate from Waterways to Bitumount would be $10.00 per ton. If a common carrier were used it would still be necessary to maintain an agent in Waterways and also to unload all freight at Bitumount. Deliveries would also be tied to scheduled trips which would be much less convenient

During December to March inclusive air transport of essential items and passengers was resorted to with planes landing on the river ice. This of course is costly and uncertain due to weather.

When limited to the methods outlined above there were two periods during freeze up and break up when the plant was cut off from the outside. This was most unsatisfactory

AIRSTRIP

and highly dangerous. To circumvent this situation a 2000 foot airstrip was constructed in 1948. The strip is located 1½ miles south-east of the plant and the road originally constructed for hauling gravel connects the strip with the camp.

To permit more economical handling of freight in winter a large snowmobile mounted on skis and half tracks has been purchased to operate on the ice. This machine is capable of handling 12 passengers or one ton of freight.

Construction of roads connecting Waterways and McMurray with any point on the Oil Sand deposit is quite feasible should development warrant such action. Gravel and Oil Sand are available in large amounts and bridge timbers could be obtained locally.

Description of Plant and Operation

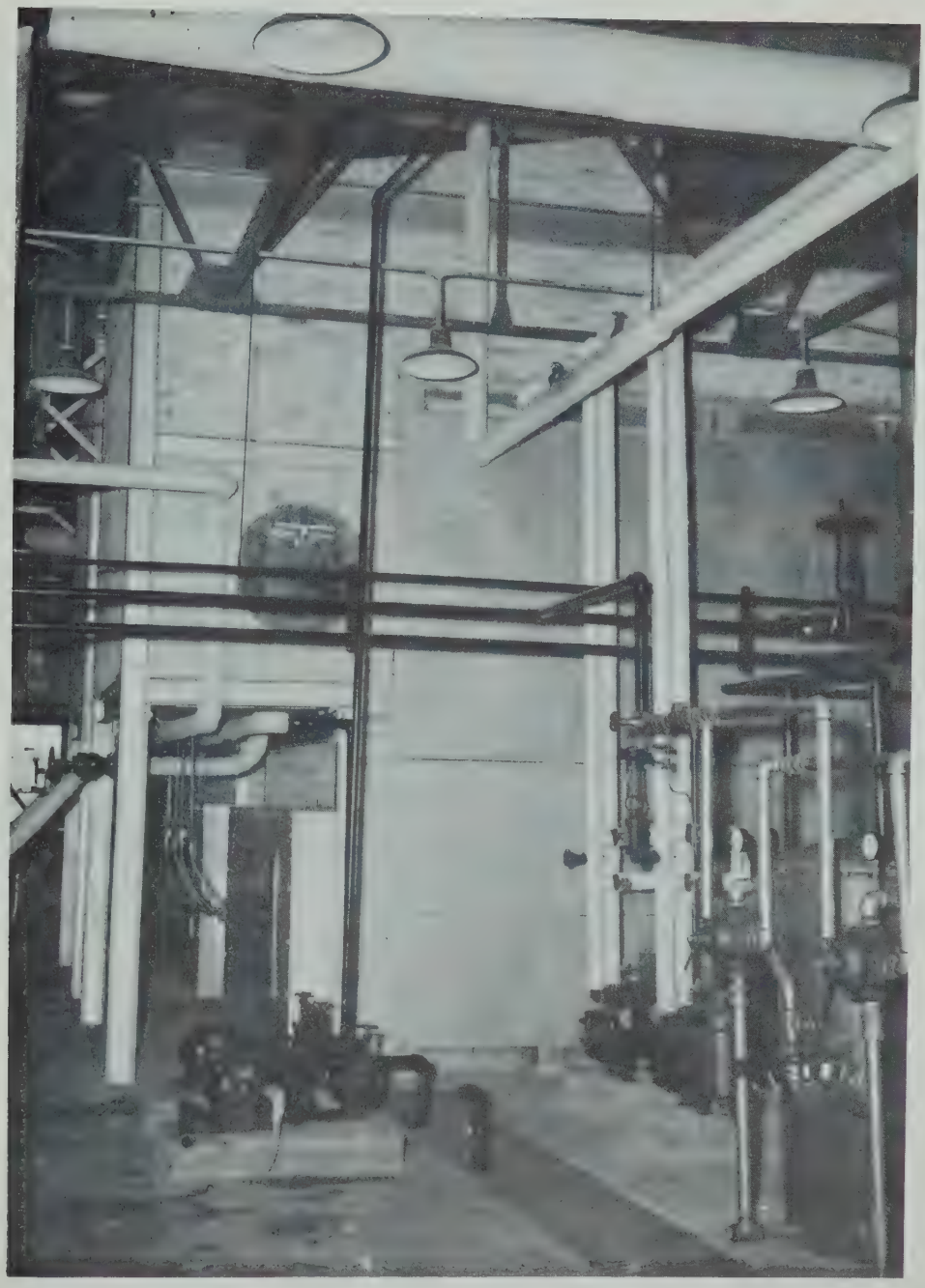
Much preparatory work was required, even after construction was finished before actual plant operations could commence.

A considerable number of forms were required on which to record salient information regarding plant operations. It was also necessary to move a stock of fuel oil and diluent to the plant for initial operations. For this purpose one of the barges belonging to the project was equipped with tanks and approximately 70,000 gallons of oil were moved from Waterways to the plant by this means. All vessels and piping were pressure tested prior to the commencement of operations and all mechanical equipment was run in for several hours to uncover possible defects.

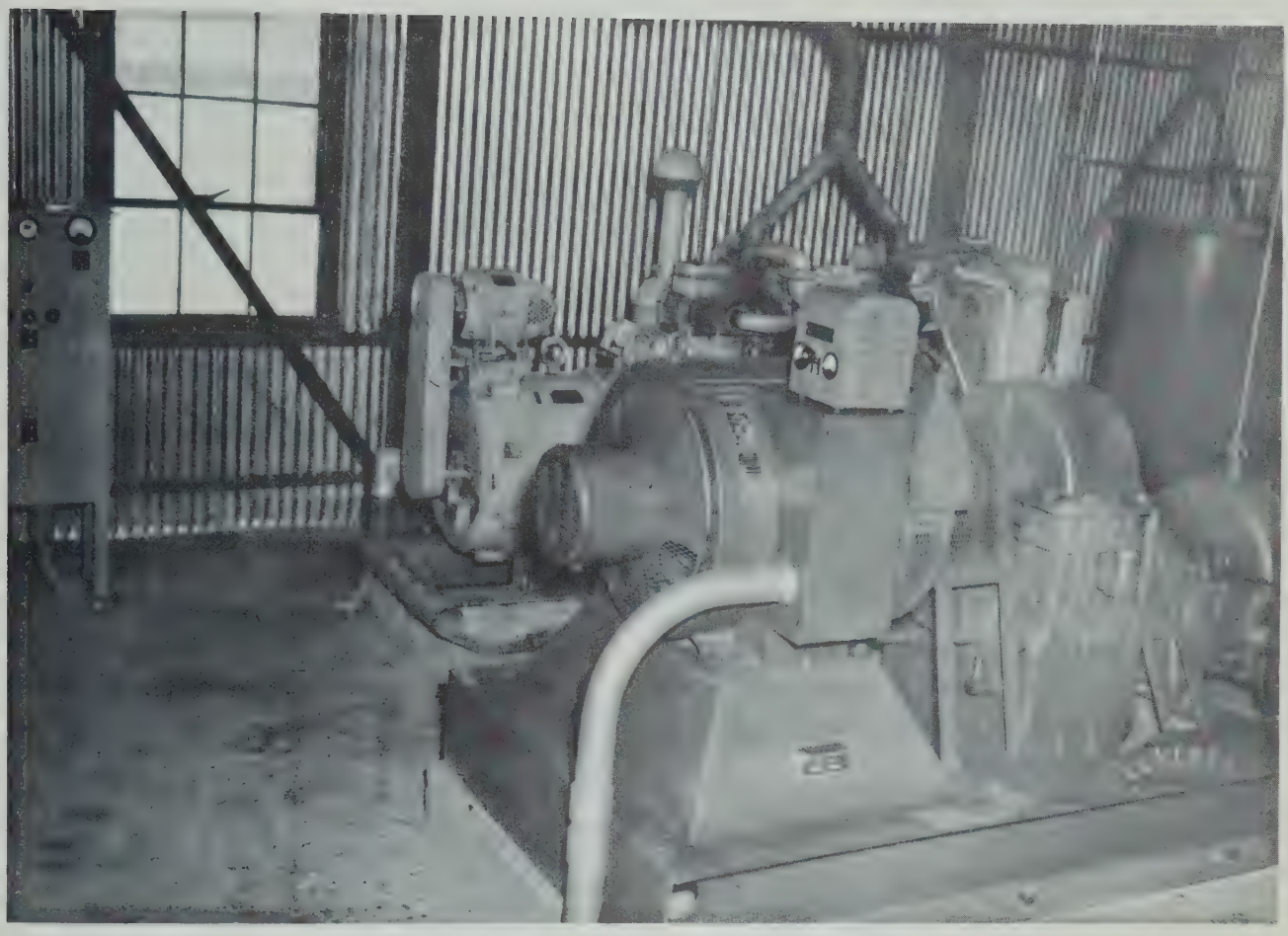
Finally a competent operating staff had to be recruited and this proved exceedingly difficult since men are naturally reluctant to leave the cities to work in such an isolated location. The problem of obtaining operators continued without improvement and at no time during the 1948 operations was it possible to obtain sufficient men to cover all shifts satisfactorily.

Power House

The Power House is a building 35' x 70' of corrugated iron on a structural steel framework.



INTERIOR OF POWERHOUSE



INTERIOR OF POWER HOUSE

SHOWING DIESEL AND TURBINE DRIVEN GENERATORS

Steam for process haeating and Power is supplied by two 6000 lb. per hour double drum water tube boilers operating at 175 pounds per square inch. These units are oil fired and have air-cooled floors and walls, which permit high operating rates.

Power is generated by a turbine driven generator rated at 347 amps per terminal. A diesel driven generator rated at 175 amps can be synchronized with the larger unit to supply peak demands or can be operated independently during shutdowns. Switching equipment permits the control of electrical power to any section of the plant and adjoining camp.

The Power House also contains filtration and chlorination equipment for water treatment; fuel oil supply tanks, pumps, and heater; feed water heater, exhaust steam accumulator, compressors, etc.

Equipment arrangement and use of automatic controls is such that labor requirements are kept to a minimum.

This unit as a whole has met every performance requirement.

Refinery

Despite the fact that separation costs are still in doubt a tremendous amount of work has been done on the processing of the crude.

Research and development organizations both in Canada and the United States have demonstrated conclusively that the separated oil presents no difficulties to modern refinery techniques and further that a full line of high grade products can be produced. Briefly, the results of these studies reveal that continuous coking of the crude gives the following approximate yields:

Liquid	75 per cent
Coke	20 per cent
Uncondensable gas	5 per cent.

The liquid overhead can be separated into distillate and gas oil fractions. Catalytic reforming of the distillate yields a high octane, low sulphur gasoline,

SETTLING TANK
WET OIL PUMPS
SEPARATION BUILDING
PRESSURE SETTLING TANK
Steam
Drain
MIXING HEATER E-9
Ratio Flow Control
E-10
Vent
Steam
To drain
Drain
DISTILLATE STORAGE
PUMP Nº 1
SETTLING SYSTEM
ACCUMULATOR
PUMP Nº 2
Starting Up by Pass
E-2
T.R.C.
Fuel
HEATER
PUMP Nº 4
Steam
WATER FLASH
E-1
E-3
Vent
Steam
Water
PUMP Nº 5
RECEIVER
PUMP Nº 9
T.C.
E-6
T.R.C.
GAS TO FUEL
Steam
Steam
Steam
E-8
Steam
Steam
Water
PUMP Nº 8
GASOLINE RECEIVER
Swing Line
R.F.O.
Steam
CRUDE STORAGE
CHARGE PUMP
PUMP Nº 3
T.R.C.
Fuel
HEATER
PUMP Nº 7
Steam
FLASH TOWER
Flow Control
E-7
E-4
Starting Up By-Pass
E-5
FRACTIONATOR
PUMP Nº 6
Gasoline To Storage 4.5 B.P.D.
Residual Fuel To Storage 306 B.P.D.
Gas Oil To Storage 8.0 B.P.D.
Distillate To Storage 30.5 B.P.D.
Distillate Recycle 245 B.P.D.

NOTE:
This Flow Diagram Was Prepared In Accordance with Flow Diagrams & Recommendations Presented in Oil Sands Ltd's Letter Dated 1-21-46 By W.E. Adkins

Revision 4 3-13-46 (PP) Pumps, Controls & Fields Modified	Revision 3 - 7-5-46 Final Change Sett. System	Revision 2 3-13-46 KWA Added Press Sett. Tk	Revision 1-Redrawn 2-11-46

DWG. 349-201

BORN ENGINEERING CO.
TULSA OKLA.

FLOW DIAGRAM
REFINERY & DEHYDRATION UNIT

FOR OIL SANDS LIMITED

DRAWN	DATE	CHECKED	APPROVED
K.W.A.	2-27-46		
TRACED	SCALE		
—	NONE		

REFINERY PUMP HOUSE

POWER HOUSE IN BACKGROUND

REFINERY AND DEHYDRATION UNIT

as does catalytic cracking of the gas oil. Polymerization of the available gas is of course recommended. No operations are involved that are not in every day use and on which ample operating experience is not available.

In view of the foregoing refining is not considered a problem with which the project has to deal and consequently the refinery is relatively simple and its chief functions will be the recovery of the diluent added and the supplying of the fuel necessary for heating, power generation, etc. Since the purpose of the project is the collection of Expermental Data it was never planned that the plant would produce commercial products or be self supporting.

The crude obtained from oil sands is unique in its susceptibility to heat treatment. Thermal decomposition is quite marked at temperatures of 500°F and lower. Because of this characteristic it is virtually impossible to subject the crude to any ordinary refining operation without some cracking taking place, and consequently, although the refining unit is basically a simple topping unit, certain features have had to be provided that will permit control of the violent decomposition.

The heater is of the end-fired Born Upflo type, and is equipped with 2 in. OD chrome-moly tubes and 1500 lb. headers. By means of heat exchange the incoming charge will be raised to approximately 500°F and the heater outlet will be carried at 750°F. At this temperature considerable decomposition takes place with coke formation but it is felt that the high proportion of distillate in the charge will increase velocities to a point where coke deposition in the heater will provide little, if any, problem

Back pressure on the heater will be controlled by an automatic back-pressure regulator. The discharge from the heater is transferred to a flash tower from the bottom of which a heavy residual fuel oil will be taken. Overhead from the flash tower will go directly to a 16-plate fractionator, the products of which will be naptha, distillate, diesel fuel, and an 18 to 20 deg API furnace oil. Fin-tube exchangers have been used exclusively in the installation both for condensing and heat recovery. Unfortunately sufficient crude was not produced during the 1948 operations to warrant starting up the refinery. However no difficulties are anticipated in its operation since standard equipment has been used throughout and design follows accepted practice.

SEPARATION BUILDING AFTER COMPLETION

SMALL BUILDING AT LEFT HOUSES AUXILIARY WATER PUMP AND SUPPLY TANK

Separation Plant

The Separation equipment is housed in a building 40' x 55' constructed of corrugated "Westile" on a structural steel frame and in a re-enforced concrete tunnel immediately under the Raw Material Hopper

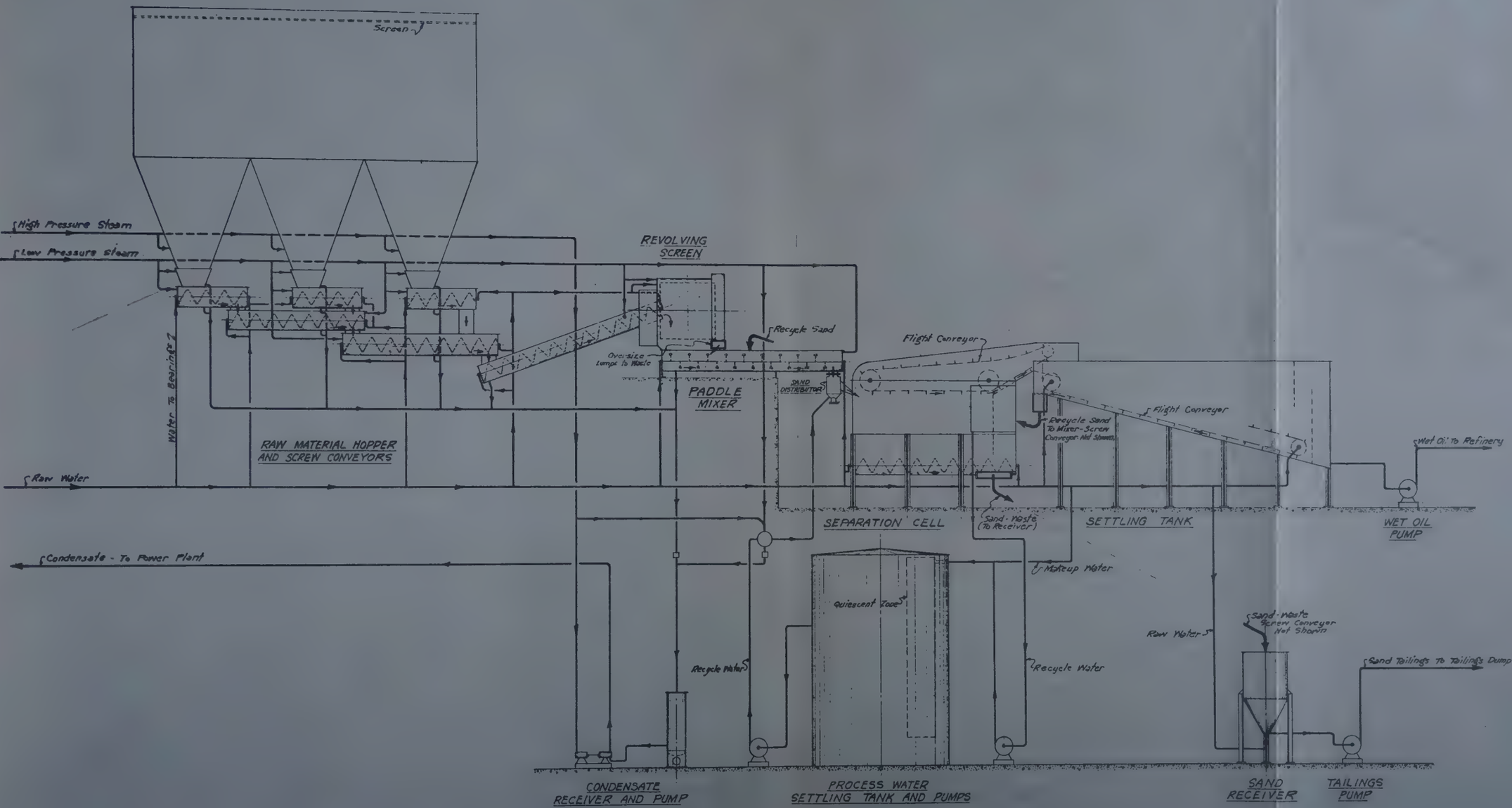
The accompanying flow sheet will aid the reader in following the separation process. Trucks discharge their loads directly into the raw material hopper from whence the oil sand is moved into the plant by a system of screw conveyors. The lower sections of the hopper are steam jacketed and equipped with steam and water jets to condition the sand for handling by the conveyors.

The oil sand enters the separation plant as a pulp and is screened to remove foreign objects before entering the mixer. The mixer is so designed that agitation is provided for about 15 minutes. During this period the oil film surrounding each grain of sand is scrubbed off and the oil particles so formed coagulated

Aeration also takes place so that an oil froth, sand, and water are discharged through the sand distributor, into the separation cell. Air can also be added at the sand distributor in controlled amounts. Aeration by entrainment of air during mixing is desirable but not always possible and must sometimes be supplemented by the addition of compressed air. However accomplished, absolute overall control of the aeration step is essential because successful flotation in the separation cell depends upon it. In the separation cell, where temperatures are controlled by the addition of heated process water, the separated oil floats as a froth and is drawn off over a launder into the settling tank. Here final deposition of mineral matter takes place. These settlings carry down oil with them and consequently must be recycled to prevent waste.

Sand tailings are removed from the separation cell by means of a screw conveyor that elevates the sand to a point above the liquid level in the cell before depositing them in the sand receiver. After dilution with water the tailings are picked up from the sand receiver by a sand pump and dishcharged onto the tailings dump.

Water is withdrawn from the separation cell continuously and settled to remove silt accumulations before



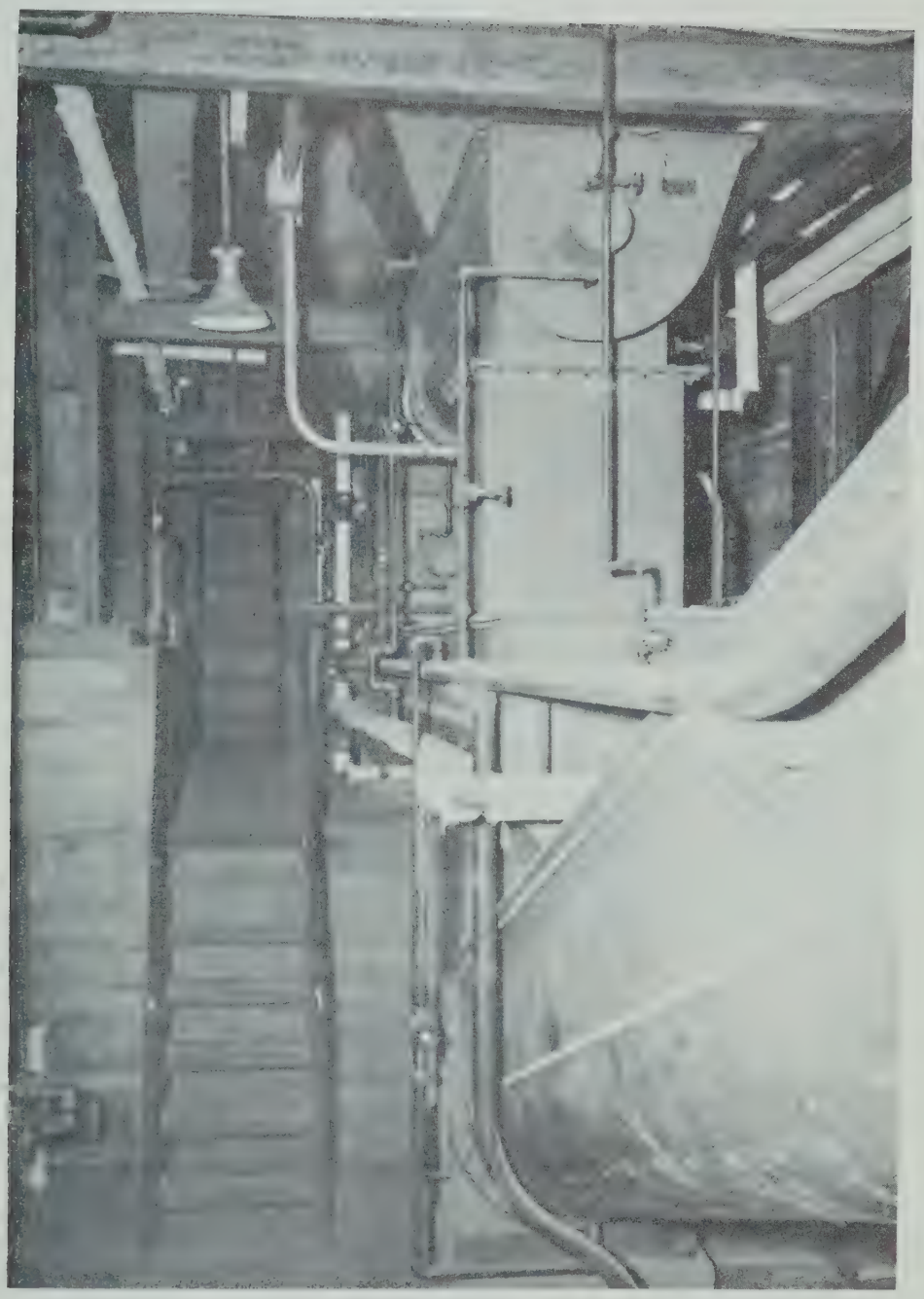
BORN ENGINEERING CO.
TULSA, OKLAHOMA

SEPARATION PLANT
FLOW DIAGRAM

FOR OIL SANDS LIMITED

DRAWN M.N.S. V.M. | DATE 8-5-46 | CHECKED C.W.K.
TRACED | SCALE NONE | APPROVED

DWG. 349-00



INTERIOR OF SEPARATION PLANT
SHOWING PART OF CONVEYOR SYSTEM

PART OF
TANK FARM

OFFICE AND
LABORATORY

PLANT FROM
NORTH-EAST

MESS HALL

GARAGE

TYPICAL STAFF CABINS

being reheated and returned to the circuit. Withdrawal and recycling of process water is handled by two 500-gpm centrifugal pumps. Heating is provided by exhaust steam in tubular exchangers.

Independent motorized reducers are used on all drives. This feature will permit a very complete study of operating conditions.

Much thought has been given to the selection of such items as journals and bearings. All bearings are water lubricated and pressure sealed by water against the entrance of abrasive material.

The separated oil leaving the settling tank is of approximately 10 deg API gravity, viscous, and contains at times as high as 30 per cent water. To facilitate handling and to promote settling of the water the oil-water mixture is diluted with a distillate in the ratio of one part distillate to two parts oil on a dry basis. Dilution was to be controlled by means of a ratio flow controller, however, this appears to be impractical as will be discussed later. The oil water distillate mixture is heated and allowed to settle in a modification of a Denver Hydro-Classifer. Laboratory work indicated that this step would eliminate about 65% of the entrained water and provision has been made in the plant to remove the balance of the water by flash vaporization. In test runs made this year, however, it was found possible by increasing the degree of dilution to drop the water content to 0.5% by settling alone. While these results will, of course, require additional checking there is hope that the whole process can be simplified by elimination of the flash vaporization step.

Laboratory

Facilities have been provided for all routine laboratory inspections of samples from various steps in the process as well as products manufactured. In addition some equipment has been provided for minor investigational work. During 1948 necessary laboratory work was done by the Alberta Research Council and it is felt desirable that this system be continued until all initial operating difficulties are overcome.

Investigational work done in Edmonton by the Research Council is covered in another Section of this report.

A CORNER OF THE WELL EQUIPPED

LABORATORY

OPERATING DIFFICULTIES ENCOUNTERED AND PROPOSED METHODS OF CORRECTION

Water Supply

The Water Pumphouse and Intake as originally constructed was located as shown on the Plot Plan approximately 590' upstream from the Separation Plant. This was done to avoid contamination from tailings and sewage which enters the river just north of the Separation Plant.

When the Intake Lines were laid on January 30, 1948 they were in approximately 7' of water which was considered adequate in view of the fact that the water is usually lowest at this time of year. Due to unprecedented shifting of the sand following breakup the Intake lines were covered by sand which had reached a depth of 4' by early August. A dredge operated by the Federal Department of Public Works was brought in but was unable to improve the situation. In order to avoid further delay in starting test runs the pump was moved from the Pumphouse and installed on a temporary mounting at the South End of the Dock.

The condition of the river continued to deteriorate and when operations were suspended on October 22, 1948 there was only about 1' of water in the channel in front of the plant.

Various ideas for correcting this situation were discussed and it was finally concluded that nothing short of a major diversion scheme would help unless the large bar south of the plant cuts out during the spring breakup. Since the river has a natural tendency to remain on the east side there is an excellent chance that this will happen.

It should be pointed out that while there is every hope of a natural solution as outlined above results cannot be guaranteed. Further until a definite channel can be re-established on the east side of the river no permanent type of intake can be built. The only alternative would be an expensive diversion job and before this type of thing is undertaken it would be wise to investigate the obtainment of water from wells.

Separation Plant

While the Hot Water Separation Process as employed at Bitumount exceeded expectations as regards quality of

COMPOSITE PHOTOGRAPH SHOWING DEVELOPMENT OF BAR IN EAST CHANNEL.
SINCE THIS PICTURE WAS TAKEN BAR HAS JOINED UP WITH EAST BANK.

product and capacity several mechanical difficulties were encountered which will have to be rectified before satisfactory operation can be obtained. (It is recommended, that is following the discussion of these difficulties the reader refer to the Flow Diagram of the Separation Plant).

It was found that the Inclined Conveyors elevating into the Revolving Screen could be plugged by a lump getting into the angle at the foot of the screw. Upon investigation it was found that the manufacturer had neglected to install a baffle plate at the foot of the screw to prevent such a contingency. This is now being rectified.

In addition to difficulties which have already been corrected the Separation Cell turned out to be the bottle neck in the whole process due to inability of the Skimming Conveyor to remove the oil as fast as it was produced. It was found that if the Oil Sand Feed Rate was not kept down to its lowest possible limit the oil displaced the water in the Cell rather than floating in a relatively thin layer on top. This resulted in oil being drawn into the tailings and also being drawn into the circulating stream of plant water. Further if the operator tried to maintain the oil-water interface at the right level the combined liquid level in the Cell built up and forced water out through the Tailings Screw. It is now proposed to reduce the length of the overflow launder from the cell which will in turn reduce the necessary lift. Two methods of moving the oil froth are under consideration. One involves the installation of rotating paddles similar to those used in ore milling flotation cells and the other the use of a modification of the Link Belt flight conveyor at present in use. Link Belt are preparing drawings covering the necessary modification.

The Tailings Screw as originally fabricated failed to elevate tailings. This is attributed to failure on the part of the manufacturer to give sufficient study to the physical characteristics of the sand tailings. The installation of a steel liner in the conveyor corrected the difficulty but also caused the screw to discharge undesirably large amounts of plant water which of course cannot be tolerated since this would increase the heating load. By cutting holes at the top of the conveyor liner it was possible to divert sufficient water back into the Separation Cell to keep the heat loss down to permissable limits.

It is further planned to reduce the speed of the tailings screw so that a longer drain back period will be obtained after the sand leaves the water surface and be fore it is discharged into the tailings receiver.

Link Belt have rechecked their calculations on this screw and have given their assurance that it will have ample capacity even at the reduced speed.

As it was originally anticipated that the oil removed from the Separation Cell would contain relatively high percentages of sand a large Settler was provided in which to reduce the sand content. Since the settled sand carried sizeable amounts of oil a recycle screw was provided to return the Settlings to the mixer. In actual operation it was found that the sand content of the Separated Oil was relatively low and that the amount of sand deposited in the Wet Oil Settler was only about 2% by weight of the oil produced. Consequently the Recycle Screw as provided was much too large and when operated continuously returned large amounts of oil to the Mixer which further aggravated the overloaded condition in the Separation cell. It was further found that the Flight Conveyor as installed in the Wet Oil Settler was very unsatisfactory from a mechanical point of view and much too cumbersome in view of the small amount of Settlings it was required to handle.

In view of the foregoing it is planned to replace the present Settler with a small Thickener which is a standard piece of equipment and one from which all mechanical defects have been eliminated. It is further proposed to recycle the underflow from the Thickener by means of a small pump having a variable capacity. At the present different types of pumps are being investigated to determine which is most suitable. It is also planned to try small pumps of various types in the laboratory so that all possible information on the subject will be available before a final choice is made.

An unfortunate choice was made in the selection of the original Wet Oil Pumps. These pumps transfer the Wet Settled Oil from the Separation Plant to the Dehydration Unit. At this point the oil contains approximately 5% of mineral matter and the pumps purchased for this purpose would not handle such abrasive material. Several

types of pumps recommended for this service are now being investigated.

The Process Water Settling Tank which was installed to remove silt from the circulating stream of plant water failed to fulfil its function as it was found that the settled material could not be removed from the tank by the means provided. This tank will be converted to a thickener which is equipped with rakes to assist the removal of solids.

In making the alterations outlined above maximum use of existing equipment will be made so that purchases of new equipment can be kept to a minimum.

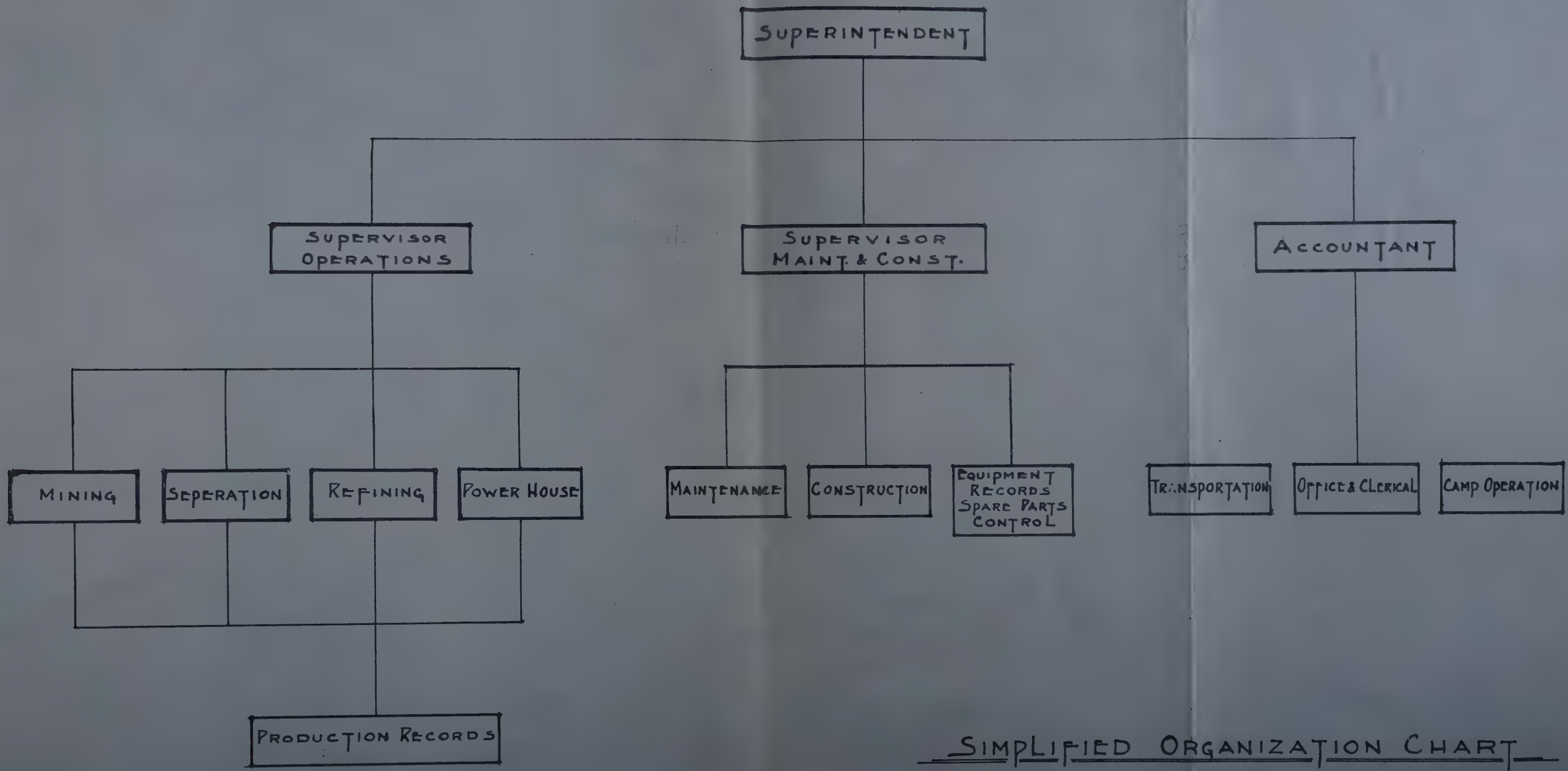
PROJECT GENERAL

Administrative

During construction the management of the project was in the hands of a Superintendent, Accountant and Supervisor of Maintenance and Construction. Shortly before operations were started a Supervisor of Operations was added. The attached simplified Organization Chart serves to indicate the functions of each.

Since the inception of the project a detailed costing system has been adhered to. During Construction each unit was costed individually and these costs were broken down into Labor and Materials and finally costs on subsections of each unit were determined. It was felt that this was necessary since the prime purpose of the project is to obtain information. Should further development take place in this area these cost figures will be of great assistance. Operating costs will be broken down as completely as possible for the same reasons.

Due to the isolated location of the project it has been necessary to provide facilities and carry out operations of considerable diversity. These have presented many management problems not usually encountered on a job of this kind. Of special note is the obtainment of correct and adequate insurance coverage. The results of efforts in this direction are reflected in very substantial improvement in premium rates over those generally obtainable in this region.



SIMPLIFIED ORGANIZATION CHART

ALBERTA GOV'T — OIL SANDS PROJECT

Personnel

The obtainment of sufficient skilled labor was a problem which was never satisfactorily eliminated. During construction much work normally done by skilled tradesmen had to be done by inexperienced men which greatly increased the burden of Supervision. In spite of this workmanship is of a high grade and labor costs are low considering the location.

In order to remain competitive in the labor market wage rates were continuously revised upward to remain in line with those being paid in other localities. The results are charted below. This also accounts for the fact that the estimated completion cost had to be revised several times.

AVERAGE HOURLY WAGE RATES

Including overtime Earnings

MONTH	YEAR		
	1946	1947	1948
Jan.	.94	#	1.11
Feb.	.79	#	1.14
Mar.	.86	#	1.25
April	.87	.89	1.06
May	.85	.99	1.19
June	.86	.94	1.21
July	.83	1.00	1.10
Aug.	.89	1.08	1.22
Sept.	.82	1.17	1.12
Oct.	.88	1.14	1.24
Nov.	#	1.02	#
Dec.	#	1.06	#

No hourly employees on payrolls.

AVERAGE NUMBER OF EMPLOYEES

Including Hourly & Monthly Employees

MONTH	YEAR		
	1946	1947	1948
Jan.	23	4	20
Feb.	32	4	22
Mar.	42	5	20
April	38	17	24
May	42	36	22
June	45	42	27
July	47	39	34
Aug.	40	35	35
Sept.	35	44	34
Oct.	23	37	34
Nov.	5	30	6
Dec.	5	12	6

ANNUAL PAYROLL

YEAR	AMOUNT
1945	$50,580.68
1946	75,269.51
1947	72,718.25
1948	71,103.89

Under operating conditions the following personnel will be Required.

Classification	No. Required
Superintendent	1
Accountant	1
Supervisor Maintenance	1
Supervisor Operations	1
Clerk	1
Warehouseman	1
Cook	1
Flunkeys	2
Caretaker	1
Operators	8
Operators Helpers	6
Steam Engineers - 2nd Class	1
Steam Engineers - 3rd Class	3
Shovel Operator	1
Tractor Operator	1
Greaser	1
Truck Drivers	3
Pipefitters	1
Welders	1
Machinist	1
Automotive Mechanic	1
Laborers	3
Pilot Engineer (Tug)	1
Helper	1
Agent Waterways	1
Chemist	1
Lab. - Assistants	3
	48

During 1948 operations total personnel never approached these numbers and serious consideration will have to be given to means of attracting men if adequate operating personnel is to be obtained.

Health Safety and Sanitation

During the initial stages of Construction it was not possible to provide modern facilities. In spite of this, better than average camp accomodation was provided and rigid standards of cleanliness enforced. As a result the general health of all employees has been excellent.

Living accomodations now available are equal to any. Bunkhouses are steam heated, have hot and cold running water, sewers, etc.

Since the closest hospital is 50 miles from the camp an active safety program has been instituted and as a result accident frequency rates have been exceptionally low as shown below.

Year	Number of Lost-Time Accidents
1946	3
1947	4
1948	1

Camp Operation

At the present time there is accomodation in the camp for four families and 63 single men. The family dwellings are not provided with facilities for the preparation of meals and all employees and their families are required to eat in the mess hall.

During periods of peak employment the Cookhouse Staff have prepared and served as high as 5400 meals per month in addition to lunches for shift workers.

Due to increased costs of material and labor the per diem charge for board and room has been revised upward several times and at present is $1.50. This, it should be pointed out, does not cover actual cost but has been purposely kept down as an added incentive to prospective employees.

INTERIOR COOK HOUSE AND DINING HALL

A laundry operated by the Project handles all bedding, etc. as well as laundry of employees desiring the service.

A well stocked commissary is maintained to supply the employees with all normal requirements. Goods are turned over at cost plus a small handling charge.

Free movies are provided weekly and other recreational equipment is available.

Maintenance Facilities

Since there are no shops or repair facilities in the area it is essential that the Project itself maintain facilities capable of handling practically any type of repair which may arise.

The Machine Shop is exceptionally well equipped and contains a Lathe, Shaper, Power Hack Saw, Grinders, Drill Presses and complete Welding Equipment. In addition there are available a portable Welding Machine, Cement Mixer, Compressor and various other pieces of equipment for jobs which are too large or heavy to conviently move to the Shop.

It is also essential that a large and representative stock of spare parts be kept on hand at all times if costly delays are to be avoided. This necessitates a comprehensive system of Spare Parts control to prevent duplications and shortages.

Fire Protection

Since no outside assistance is obtainable in the event of fire, fires however small are a matter of vital concern to all those connected with the Project.

To keep the possibility of fires to a minimum a very high standard of Housekeeping is required both inside and outside the Plant Buildings. It is worthy of note that the Fire Underwriters Inspector commented very favorably on this feature during a recent inspection.

All Plant Buildings, that is those in which actual

operations take place, are of fireproof construction and are equipped with Carbon Dioxide extinguishers and hoses. Camp buildings are of frame construction and also have Carbon Dioxide extinguishers.

Hydrants are located at strategic spots and pressure on fire lines can be boosted by auxiliary pumping equipment.

When operating crews have been hired and plant personnel is complete it is planned to organize and maintain a plant fire brigade along lines approved by the Fire Underwriters Association.

TABULATED SUMMARY OF COMPLETION COSTS OF VARIOUS PLANT UNITS

Separation Plant	$124,570.00
Refinery	72,300.00
Power House	68,025.00
Tank Farm (includes Transfer Lines & Pumphouse)	21,675.00
Service Lines (Steam, Water, Sewer, Power, etc.)	18,580.00
Site Preparation & Road Building	6,300.00
Dock	1,210.00
Pumphouse, Water Intake & Auxiliary Water Supply System	17,780.00
Machine Shop & Warehouse (including Equipment)	20,100.00
Garages (including Equipment)	5,700.00
Office & Laboratory (including Equipment)	9,090.00
Camp Buildings (includes Bunkhouses, Mess Hall Staff Cabins, Laundry & Service Buildings & Equipment)	39,050.00
Engineering, Design & Supervision	82,460.00
Transportation (includes unloading at Waterways reloading & transporting to Bitumount & unloading at Plant Site)	31,000.00
Airstrip	675.00
Overhead Charges (includes Insurance, Compensation, Travelling Expense, Telephone, Telegraph, Stationery, Unemployment Insurance, Postage, etc.)	43,940.00
Maintenance of Construction Equipment (includes Trucks, Shovel, Tractors, Cement Mixers, Welding Machines and Power Plant Operation)	27,750.00
Camp Operation (includes Maintenance of Camp Buildings, Heating, Laundry Operation, Caretakers, Salaries, Loss on Cookhouse Operation, etc.)	26,500.00
Project Equipment (includes Trucks, Tractors, Shovel, Boats, Barges, Tools, Portable Welding Machines, etc.)	65,460.00
Warehousing	5,480.00

NOTE: Although a final audit has not been completed the figures presented above give reasonably accurate statement of expenditures on the Project to the close of Construction.

Breakdown of Wages & Salaries during Construction Period (June 1945 - Aug. 1948) incl.

Total Payrolls		$252,790.77
Logging & Sawmill Operation	35,357.00	
Transportation	24,270.07	
Mine Development & Stripping debited to Operations	3,000.00	
Superintendents & Office Salaries	28,585.68	
	91,212.75	91,212.75
Actual Construction Wages Paid		$161,578.02

NOTE: Cookhouse and Camp Wages have been included with Construction Wages since loss on Camp Operation was purposely taken as an added inducement to employees.

Actual Construction Labor therefore constituted 22.8% of the total cost of the Project. It is interesting to note that Refinery Contractors are currently advertising Labor Costs at 40% of Total Project cost.

Breakdown of Operating Expenditures

Plant Operating Wages	16,526.68	
Transportation	1,539.00	
Camp Operation	1,950.00	
Supervision	3,214.00	
	23,229.68	23,229.68
Supplies Purchased & Consumed		6,195.00
Supplies Purchased & On Hand		
Warehouse	32,729.69	
Cookhouse	7,910.80	
Commissary	3,510.70	
Products in Storage and in Process	7,468.24	51,619.43
Overhead Expense		2,955.62

Includes Stationery, Telephone, Telegraph Insurance, Unemployment Insurance, Travelling Expense, Employees Transportation, etc.

Loss on Camp Operation in addition to Wages	946.00

Summary of Operating Expenditures

Operating Expense to Dec. 31, 1948	33,326.30
Inventories	51,619.43
	84,945.73

A sizeable percentage of the Operating Expenses were incurred before Actual Operations Commenced. This money was used to cover the cost of Mine Stripping, Operator Training, Equipment Testing and other necessary preparatory work.

SUMMARY OF OPERATIONS

Stripping

No. of Cubic Yards of Overburden removed	Total Stripping Cost	Cost per Yard
35,000	7,583.40	21.6 cents

Mining

Total Oil Sand Mined	No. Truck Loads Delivered to Plant	Average Weight Per Load
614.5 Tons	138	4.45 Tons

Due to the small amount of Oil Sand mined and the intermittent nature of the operation it is impossible at this time to determine accurate mining costs. Time Studies made however indicate that trucks can operate on an 8 minute cycle. On this basis it will be entirely possible to mine sufficient sand for 24 hours operation during one 8 hour shift, and using two trucks continuously. Under these conditions the shovel will not be working at capacity.

TABULATION OF OPERATING RESULTS

Tons Oil Sand Processed	(3) Average % Oil By Weight	Wet Oil Produced Gallons	Diluent Added Gallons	Loss During Settling Gallons	Diluted Crude On Hand
535.5	9.0	14833	7145	5191	16,787

Actual Crude Produced Gallons	Actual Operating (1) Time	Production Rate (2) Gallons/Hour
9642	56 Hours	172.18

(1) Times for several short runs rangeing from 1 to 3 hours have not been included since the amount of oil produced in each was negligible and of doubtful quality.

(2) As was explained previously it was only feasible to feed Oil Sand at one third of the possible rate due to the inability of the Skimmers to remove the oil from the Separation Cell fast enough.

(3) This represents the average oil content of the lean upper layer in the mine. Removal of a relatively small amount of this material will leave beds averaging 15% oil by weight.

Analysis of Oil Produced

Crude Bitumen leaving Separation Plant.

Oil	64.4
Water	30.1
Mineral Matter	5.5
Gravity of Oil	10° A.P.I.

Diluted & Settled Crude

Oil	99.0%
Water	0.5%
Mineral Matter	0.5%
Gravity	23° A.P.I.

Discussion of Operating Results

Assuming that the bottleneck in the Separation Cell can be removed by the installation of more efficient Skimmers then the Oil Sand Feed Rate can be increased 300 per cent. This will have the effect of increasing the Production Rate to 516.54 gallons per hour or approximately 355 barrels per day. Further when the lean sand at present being mined has been disposed of and the charge consists of 15% sand then the oil production rate will approximate 600 barrels per day while the actual tonnage of sand processed will remain constant.

Due to the relatively short length of time the Separation Plant was in operation and the intermittent nature of the runs, no attempt is being made at this time to determine production costs as these figures would be meaningless.

In Conclusion one further activity of the Oil Sands Project is worthy of mention. Several major oil Companies are at present carrying on investigational work related to both the Separation and Refining of oil from Oil Sands. Members of the Project Staff are continuously in touch with these organizations. Samples of both sand and oil aggregating several tons have been prepared and shipped to further this work. It is hoped that the results of these experiments will contribute to a final and successful solution to the problems connected with Alberta's largest natural resource.

Research Council of Alberta Participation in the Oil Sands Project

K.A. Clark, Dec. 1948.

Relationship of the Council to the Project.

The Research Council of Alberta has a close association with the Oil Sands Project even though it has not been charged with direct responsibility for carrying it out. Bituminous sand research has been an activity of the Council since its inception in 1920. During its life it has accumulated a store of knowledge about the bituminous sands both from its own studies and from being in contact with about everyone out side its organization who has worked on the bituminous sands. It has been the intention from the start of the Oil Sands Project that the knowledge possessed by the Research Council should be brought to bear on the Project and be used where applicable. Consequently it has been understood that the Research Council organization, - Drs. K.A. Clark and D.S. Pasternack in particular, - should keep and be kept in close touch with the progress of the Project and should help in appropriate ways. This rather loose liaison has worked quite well. Research Council and Oil Sands Project personnel have maintained close and harmonious relation ships with each other. Dr. Clark has been included in staff meetings with the Board of Trustees. Problems arising from the Project which called for laboratory study have been given priority in the Research Council's bituminous sand program and have been carried out promptly.

Original Design of the Bitumount Plant.

It was understood at the start of the Oil Sands Project that the separation plant was to be designed to carry out the hot water separation process in accordance with the principles developed by the Research Council of Alberta. This understanding meant that the Bitumount separation plant would differ in important features of process from the plants of the International Bitumen Co. and of Abasand Oils Ltd. This understanding has never been questioned. When the original flowsheet was drawn up, Mr. Neilsen for Oil Sands Ltd. and Drs. Clark and Pasternack got together and arranged the flowsheet so that it conformed with the Research Council's method or process of separation. This flowsheet has been adhered to and is the flowsheet of the plant that has been constructed at Bitumount.

It was never understood that the ideas of Research Council personnel about the mechanical engineering involved in assembling a separation plant should have right-of-way. These ideas were "put in the pot" along with those of Oil Sands Ltd. personnel and, later, of the Born Engineering Co. There was considerable divergence of thought in regard to types of equipment and details of design of vessels. This was inevitable as the design of a separation plant is a novel undertaking. Actual experience in building and operating them is very limited. The final design of the Bitumount plant in regard to equipment for handling materials into, through and out of the plant was the resultant of the ideas of all concerned. And it should be said that all concerned agreed to the final design even though they may have preferred something different in certain respects.

Dehydration Unit.

The construction of the plant at Bitumount was under way before a decision was reached about the design of the Dehydration Unit. This is the part of the plant in whih the very wet, somewhat sandy crude oil produced in the Separation Unit is rid of its water and sand contents and is prepared for charging to the refinery. A sharp controversy arose over what should be provided in the way of a Dehydration Unit. As a result of the controversy, the Research Council undertook an extensive laboratory examination of the various methods of water elimination that were being argued about. The matter was a serious one because a method that would work was essential. The Separation Unit, the Dehydration Unit and the Refinery form a cycle. Each unit of the cycle must function and keep in step with the others. Otherwise none of them can function. The laboratory investigation led to a definite conclusion and this conclusion was adopted. The Dehydration Unit was designed in accordance with the recommendations forthcoming from the investigation and was installed.

Plant Laboratory.

A laboratory at Bitumount was required for purposes of plant control as well as for obtaining operational data and for other studies that would, in all probability, become desirable. Since laboratory work was the field of the Research Council it has become understood that the Council should take responsibility for the laboratory and its operation. Consequently the laboratory has been laid out in accordance with the wishes of the Research Council and has been equipped by it.

It was the expectation that the plant would have been completed last spring or early summer and would have been in operation for the rest of the season. In accordance with this expectation the Research Council engaged a laboratory staff of six Chemical Engineering students for the inter-varsity period of four and a half months. It was understood that the students would assist in the general work of construction until the plant went into operation. Because of the fire and other delays the attemp to start operations was not made until after the students had returned to the university for the fall term. So far there has been almost no opportunity to use the laboratory for plant purposes. However, some work has been done in it mainly to be sure that it is in proper order for functioning.

Problems Arising from Plant Operations.

Scope for co-operation between the Research Council and the Oil Sand s Project will increase when the plant gets into operation. There is much work to be done in collecting data about operations with the plant as completed. The plant is largely experimental in purpose and all the information possible should be got out of it and made available. Undoubtedly plant problems will arise which will require laboratory investigation. The role of the Research Council in these connections is obvious.

Problems have arisen already. The short operation of the plant at the close of the 1948 season revealed some shortcomings in mechanical equipment. Laboratory testing of alternative types of equipment is indicated as desirable in arriving at a decision about alterations. Work is in progress at present at the Research Council laboratories at the university. This work has to do with modifications to the inclined

screw conveyor for removing sand tailings from the separation cell, with another method of removing tailings and with the handling of sandy settlings out of the crude oil settler.

Thought and some work is being directed toward two other problems which are in sight. These are a further, secondary recovery of oil from the separation plant water; and recovery of oil from the oil-water emulsion which forms in the Dehydration Unit.

In conclusion it may be recorded that co-operation between the Research Council of Alberta and the Oil Sand Project has been satisfactory to date and that there is no apparent reason why it cannot be expected to continue to be satisfactory.